CRM 86-135 / May 1986

EFFECTS OF USING SUBTEST STANDARD SCORES IN CALCULATING AFQT PERCENTILE SCORES

Gary E. Horne

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Work conducted under contract N00014-83-C-0725.

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REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION / AVAILABILITY OF REPORT APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) CRM 86-135	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Center for Naval Analyses 6b. OFFICE SYMBOL (*If applicable*) CNA	7a. NAME OF MONITORING ORGANIZATION Commandant of the Marine Corps (Code RD)
6c. ADDRESS (*City, State, and ZIP Code*) 4401 Ford Avenue Alexandria, Virginia 22302-0268	7b. ADDRESS (*City, State, and ZIP Code*) Headquarters, Marine Corps Washington, D.C. 20380
8a. NAME OF FUNDING / ORGANIZATION Office of Naval Research 8b. OFFICE SYMBOL (*If applicable*) ONR	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER N00014-83-C-0725
8c. ADDRESS (*City, State, and ZIP Code*) 800 North Quincy Street Arlington, Virginia 22217	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 65153M; PROJECT NO. C0031; TASK NO.; WORK UNIT ACCESSION NO.
11. TITLE (*Include Security Classification*) Effects of Using Subtest Standard Scores in Calculating AFQT Percentile Scores	
12. PERSONAL AUTHOR(S) Gary E. Horne	
13a. TYPE OF REPORT Final 13b. TIME COVERED FROM TO	14. DATE OF REPORT (*Year, Month, Day*) May 1986 15. PAGE COUNT 28
16. SUPPLEMENTARY NOTATION	

17. COSATI CODES		
FIELD	GROUP	SUB-GROUP
05	09	
05	09	

18. SUBJECT TERMS (*Continue on reverse if necessary and identify by block number*)
AFQT (Armed Forces Qualification Test), Aptitude tests, ASVAB (Armed Services Vocational Aptitude Battery), Computer applications, Enlistment qualifications, Intelligence tests, Mental ability, Qualifications, Recruits, Scoring, Subtests, Tables (data), Test scores

19. ABSTRACT (*Continue on reverse if necessary and identify by block number*)

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20. DISTRIBUTION / AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL Lt. Col. G. W. Russell	22b. TELEPHONE (*Include Area Code*) (202) 694-3491 22c OFFICE SYMBOL RDS-40

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1 July 1986

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Subj: Center for Naval Analyses Research Memorandum 86-135

Encl: (1) CNA Research Memorandum 86-135, "Effects of Using Subtest Standard Scores in Calculating AFQT Percentile Scores," May 1986

1. Enclosure (1) is forwarded as a matter of possible interest.

2. The Armed Services Vocational Aptitude Battery (ASVAB) is used by all branches of the armed services to measure the mental aptitudes of applicants for enlistment. A part of the ASVAB, known as the Armed Forces Qualification Test (AFQT), is used by the Department of Defense as a measure of general aptitude for training.

3. The existence of certain AFQT percentile scores such as 21, 31, and 50 is essential to the smooth application of enlistment standards. This Research Memorandum shows that, depending on the method by which AFQT is calculated, some of these critical score values will not occur.

William H. Sims
Director
Marine Corps Manpower
and Training Program

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EFFECTS OF USING SUBTEST STANDARD SCORES IN CALCULATING AFQT PERCENTILE SCORES

Gary E. Horne

Marine Corps Operations Analysis Group

A Division of CNA *Hudson Institute*

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ABSTRACT

The Armed Forces Qualification Test (AFQT) is currently constructed from a sum of subtest raw scores converted to percentile scores. This paper examines advantages and disadvantages of constructing AFQT percentile scores from sums of subtest standard scores.

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EXECUTIVE SUMMARY

The Armed Services Vocational Aptitude Battery (ASVAB) consists of 10 subtests. The Armed Forces Qualification Test (AFQT) is a composite of certain ASVAB subtests and is used by all services to help establish the qualifications of applicants for enlistment. The current AFQT includes the Numerical Operations subtest, which is a speeded test. Because of problems with the speeded tests, the services are considering alternative AFQT composites to replace the current AFQT.

Currently the AFQT score is calculated as the sum of subtest raw scores expressed as a percentile score. The purpose of this study is to examine the effects of using subtest standard scores instead of raw scores to compute AFQT percentile scores.

It is very desirable that the table converting AFQT scores into percentile form has no missing percentile points (gaps). An AFQT composite with more gaps in the conversion tables from AFQT score to AFQT percentile is less discriminating than an AFQT composite with fewer gaps. In practice, the gaps are either tolerated or they are artificially closed, but neither of these situations is desirable.

Scores from three alternative AFQT composites were computed from subtests in both raw and standard score form and examined to determine what gaps exist. The 1980 Youth Population was used as the data base in these examinations.

The results are summarized in table I. These results indicate that the use of standard scores instead of raw scores could help alleviate the problem of percentile score gaps, depending on which potential AFQT composite is chosen. In particular, the new AFQT recently proposed by the Joint Service Selection and Classification Working Group consisting of the Verbal, Arithmetic Reasoning, and Math Knowledge subtests would contain approximately 23 gaps if based on raw scores but only 8 gaps if based on standard scores.

TABLE I

NUMBER OF PERCENTILE SCORE GAPS FOR ALTERNATIVE AFQT COMPOSITES

Composite[a]	Type of score form	Number of gaps[b]
VE + AR + NO/2	Raw	5
VE + AR + GS + MK	Raw	13
VE + AR + MK	Raw	23
2VE + 2AR + MK	Raw	0
VE + AR + GS + MK	Standard	0
VE + AR + MK	Standard	8
2VE + 2AR + MK	Standard	0
WK + PC + AR + GS + MK	Standard	0
WK + PC + AR + MK	Standard	1
2WK + 2PC + 2AR + MK	Standard	0

a. VE = Verbal = Word Knowledge + Paragraph Comprehension
AR = Arithmetic Reasoning
NO = Numerical Operations
GS = General Science
MK = Mathematics Knowledge
WK = Word Knowledge
PC = Paragraph Comprehension.

b. A gap is defined as a percentile score that has no corresponding composite score. Cumulative percentages were calculated to one decimal place for each of the composites for the 1980 Youth Population. These percentages were rounded to determine the percentile corresponding to each composite score. Smoothing techniques were not used.

There are several advantages to constructing the AFQT from subtest standard scores versus subtest raw scores:

- Equal weight could be given to each subtest despite differences in number of items, mean scores, and standard deviations.
- One AFQT table would handle all current forms of the ASVAB.
- The table would not need to be changed when new forms of the ASVAB are introduced.
- Missing percentile scores (gaps) in the AFQT conversion table are minimized.

Using an AFQT based on subtest standard scores also has at least one important disadvantage:

- Computations of preliminary AFQT score percentiles at Mobile Examining Team (MET) sites would require more steps.

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INTRODUCTION

The Armed Services Vocational Aptitude Battery (ASVAB) is used by all branches of the armed services to measure the mental aptitudes of applicants for enlistment. The ASVAB consists of 10 subtests that are combined in various ways to form aptitude composites. These composites are designed to show ability in different areas.

The Armed Forces Qualification Test (AFQT) is a composite designed to be an indicator of general trainability [1] and is used by all services to help establish the qualifications of applicants for enlistment. The AFQT is used to screen out applicants at lower ability levels and to help determine eligibility for enlistment guarantees and bonuses [2].

Currently, the AFQT composite score is calculated by adding the raw scores of the ASVAB subtests Word Knowledge (WK), Paragraph Comprehension (PC), Arithmetic Reasoning (AR), and one-half of the Numerical Operations (NO) score (current AFQT = raw VE + raw AR + raw NO/2, where raw VE is the sum of raw WK + raw PC). This raw score sum is converted into a percentile score, and applicants are grouped into categories based on their percentile scores.

The current AFQT includes NO, which is a speeded test. Because of problems with the speeded tests, such as those documented in [3, 4, 5], all four services were asked to submit ASVAB composites as candidates to replace the current AFQT. The purpose of this study is to examine the effects of using standard scores instead of raw scores in determining AFQT percentile scores if the current AFQT composite is changed.

The major advantage of using raw scores to determine AFQT percentile scores is ease of scoring. After the applicant takes the ASVAB, the AFQT can be hand scored at Mobile Examining Team (MET) sites by summing the number correct on WK, PC, and AR, plus one-half the number correct on NO. One table look-up then yields the applicant's AFQT percentile score. The use of standard scores would require a table look-up for each subtest in the AFQT and one last table look-up after the subtest standard scores were summed.

One advantage of using standard scores is that they equalize the weight given each subtest despite differences in number of items, mean scores, and standard deviations. For example, suppose it was determined that equal importance should be ascribed to VE and AR in determining the AFQT score.

By summing the standard VE score and the standard AR score, both tests will have equal weight. This occurs despite the fact that VE has 50 items with a mean of approximately 37 and a standard deviation of about 11 whereas AR has only 30 items with a mean of approximately 18 and a standard deviation of about 7.

Two separate tables are being used for the current forms of the ASVAB (one is for form 12a; the other is a 5-form average of forms 11a, 11b, 12b, 13a, and 13b). If standard scores are used, only one table providing conversions from sums of subtest standard scores to percentile scores would be required. Also, this table would not need to be changed when new forms of the ASVAB are introduced, as long as the 1980 Youth Population is used as the reference population.

An important issue is percentile scores that do not have a corresponding AFQT composite score (called gaps). An AFQT composite with more gaps in the conversion tables from AFQT score to AFQT percentile is less discriminating than an AFQT composite with fewer gaps. Gaps at the critical 10th, 21st, 31st, and 50th percentile scores, which are frequently used in personnel decisions, are particularly troublesome. In practice, gaps are either tolerated or they are artificially closed by "gerrymandering"; neither outcome is desirable.

DATA

During the summer of 1980, the ASVAB was administered to a nationally representative sample of 11,914 men and women born 1957 through 1964 [2]. The 1980 Youth Population came from this sample and was used to construct the current ASVAB score scale. Thus, the 1980 Youth Population was used in the present study to determine where a percentile score has no corresponding composite score.

The 1980 Youth Population was obtained from the original sample by selecting the 18 to 23 year olds; anyone under 18 was edited out. Records of 36 people who were administered the test in a nonstandard way were also edited out. The data was then weighted to reflect the 1980 population by age, gender, and race/ethnic group.

METHODOLOGY

Using the 1980 Youth Population, percentile gaps were calculated for the current AFQT composite and three of the alternative AFQT composites that were submitted as candidates to replace the current AFQT. These three alternatives are as follows:[1]

- Verbal + Arithmetic Reasoning + Math Knowledge + General Science
- Verbal + Arithmetic Reasoning + Math Knowledge
- 2 * Verbal + 2 * Arithmetic Reasoning + Math Knowledge.

These three composites will be referred to as ALT A, ALT B, and ALT C respectively. These alternatives were chosen because they appear to be the three most desirable in terms of their predictive validity and effect on the applicant pool [6].

The AFQT alternative composites calculated from subtest scores for the 1980 Youth Population were expressed in the following three forms:

- Raw score form
- Standard score form with one standard score for Verbal
- Standard score form with separate standard scores for Word Knowledge and Paragraph Comprehension.

Cumulative percentages were then calculated to one decimal place for the three score forms for each of the composites. These percentages were then rounded to the nearest whole number to determine the percentile corresponding to each composite score value. Any percentile score that had no corresponding composite score value was noted as a gap.

1. Note that Verbal = Word Knowledge + Paragraph Comprehension.

RESULTS

Cumulative percentages for the current AFQT score values and the three types (called RAW, STD1, and STD2) of each of the three alternatives appear in appendix A. (The computer program used to calculate AFQT score values for each of the various ways of defining the AFQT appears in appendix B.) The percentile gaps were determined from these tables; they are summarized in table 1.

The current AFQT shows five gaps. Note that these gaps can be eliminated by smoothing techniques because of the uneven characteristic of the distribution of scores at values close to the gaps.

ALT A shows 13 gaps in raw score form. These gaps cannot be eliminated by smoothing. In both standard score forms no gaps appear. ALT B shows 23 gaps in raw score form, one of which is at the critical percentile score of 50. ALT B also shows eight gaps in the standard score form with Verbal as one unit and one gap in the standard score form with Verbal split. The gaps for ALT B in the first two forms cannot be eliminated by smoothing. ALT C shows no gaps in any of the three forms.

CONCLUSION

Defining the AFQT in terms of subtests expressed in subtest standard score form would greatly reduce gaps in the resultant AFQT percentile score tables.

TABLE 1

PERCENTILE SCORE GAPS FOR ALTERNATIVE AFQT COMPOSITES

Composite	Number of gaps	Percentile scores where gaps occur
Current	5	59 74 78 88 97
RAW ALT A	13	35 43 48 52 57 60 64 68 72 77 83 87 94
RAW ALT B	23	28 33 38 40 44 47 50 54 57 59 62 64 67 70 73 76 79 83 85 88 91 94 97
RAW ALT C	0	–
STD1 ALT A	0	–
STD1 ALT B	8	37 46 55 60 64 72 85 93
STD1 ALT C	0	–
STD2 ALT A	0	–
STD2 ALT B	1	69
STD2 ALT C	0	–

Current = RAW VE + RAW AR + (RAW NO/2)
RAW ALT A = RAW VE + RAW AR + RAW GS + RAW MK
RAW ALT B = RAW VE + RAW AR + RAW MK
RAW ALT C = 2(RAW VE) + 2(RAW AR) + RAW MK
STD1 ALT A = STD VE + STD AR + STD GS + STD MK
STD1 ALT B = STD VE + STD AR + STD MK
STD1 ALT C = 2(STD VE) + 2(STD AR) + STD MK
STD2 ALT A = STD WK + STD PC + STD AR + STD GS + STD MK
STD2 ALT B = STD WK + STD PC + STD AR + STD MK
STD2 ALT C = 2(STD WK) + 2 (STD PC) + 2(STD AR) + STD MK

REFERENCES

[1] United States Military Entrance Processing Command. *Test Manual for the Armed Services Vocational Aptitude Battery.* North Chicago, Illinois, Jul 1984

[2] Office of the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics). *Profile of American Youth: 1980 Nationwide Administration of the Armed Services Vocational Aptitude Battery.* Washington, DC: U.S. Government Printing Office, Mar 1982

[3] CNA, Memorandum 83-3102, *The Appropriateness for Military Applications of the ASVAB Subtests and Score Scale in the New 1980 Reference Population*, by William H. Sims and Milton H. Maier, Unclassified, 26 Jun 1983

[4] CNA, Research Memorandum 86-86, *Inconsistent Scores on Speeded ASVAB Subtests*, by Gary E. Horne, Unclassified, Apr 1986

[5] Air Force Human Resources Laboratory, TR-85-14, *Armed Services Vocational Aptitude Battery: Correcting the Speeded Subtests for the 1980 Youth Population*, by Toni G. Wegner and Malcolm J. Ree, Unclassified, Jul 1985

[6] CNA, Research Memorandum 86-111, *Evaluation of Alternative Compositions of the Armed Forces Qualification Test (AFQT)*, by Gary E. Horne, Unclassified, May 1986

TABLE A-1

CUMULATIVE PERCENTAGES FOR CURRENT AFQT (RAW VE + RAW AR + RAW NO/2) SCORE VALUES

VALUE	CUM %	VALUE	CUM %	VALUE	CUM %	VALUE	CUM %
.0	.0	29.5	3.5	55.0	19.8	80.5	54.5
.5	.0	30.0	3.7	55.5	20.3	81.0	55.1
1.0	.0	30.5	3.9	56.0	20.8	81.5	56.3
2.0	.0	31.0	4.1	56.5	21.4	82.0	57.4
2.5	.0	31.5	4.3	57.0	21.9	82.5	58.4
3.0	.0	32.0	4.6	57.5	22.4	83.0	59.6
4.0	.0	32.5	4.8	58.0	22.6	83.5	60.7
5.0	.0	33.0	5.0	58.5	23.2	84.0	62.0
5.5	.0	33.5	5.1	59.0	23.6	84.5	62.9
6.0	.1	34.0	5.4	59.5	24.1	85.0	64.4
7.0	.1	34.5	5.6	60.0	24.6	85.5	65.3
7.5	.1	35.0	5.8	60.5	25.1	86.0	66.3
8.0	.1	35.5	6.0	61.0	25.6	86.5	67.2
8.5	.1	36.0	6.2	61.5	26.3	87.0	68.2
9.0	.1	36.5	6.5	62.0	26.7	87.5	69.0
9.5	.1	37.0	6.6	62.5	27.3	88.0	70.0
11.5	.2	37.5	7.0	63.0	27.8	88.5	70.9
12.0	.2	38.0	7.3	63.5	28.2	89.0	72.1
12.5	.2	38.5	7.5	64.0	28.9	89.5	73.2
13.0	.2	39.0	7.8	64.5	29.6	90.0	74.5
14.0	.3	39.5	8.2	65.0	30.5	90.5	75.5
14.5	.3	40.0	8.4	65.5	31.0	91.0	76.5
15.0	.3	40.5	8.7	66.0	31.6	91.5	77.4
15.5	.4	41.0	9.1	66.5	32.3	92.0	78.7
16.0	.4	41.5	9.4	67.0	33.0	92.5	79.6
16.5	.4	42.0	9.8	67.5	33.9	93.0	81.0
17.0	.5	42.5	10.0	68.0	34.6	93.5	81.6
17.5	.6	43.0	10.3	68.5	35.4	94.0	83.0
18.0	.7	43.5	10.7	69.0	36.1	94.5	83.8
18.5	.8	44.0	11.0	69.5	36.7	95.0	84.7
19.0	.8	44.5	11.3	70.0	37.3	95.5	85.6
19.5	.9	45.0	11.6	70.5	38.2	96.0	86.7
20.0	1.0	45.5	12.1	71.0	39.0	96.5	87.3
20.5	1.1	46.0	12.5	71.5	39.8	97.0	88.8
21.0	1.1	46.5	12.8	72.0	40.7	97.5	89.7
21.5	1.2	47.0	13.1	72.5	41.4	98.0	91.0
22.0	1.3	47.5	13.6	73.0	42.3	98.5	91.5
22.5	1.4	48.0	13.9	73.5	43.3	99.0	92.7
23.0	1.6	48.5	14.3	74.0	44.0	99.5	93.3
23.5	1.7	49.0	14.6	74.5	44.8	100.0	94.2
24.0	1.8	49.5	14.9	75.0	45.3	100.5	94.9
24.5	1.9	50.0	15.3	75.5	46.1	101.0	96.0
25.0	2.1	50.5	15.8	76.0	46.7	101.5	96.4
25.5	2.2	51.0	16.1	76.5	47.4	102.0	97.5
26.0	2.4	51.5	16.5	77.0	48.1	102.5	97.8
26.5	2.5	52.0	16.9	77.5	49.3	103.0	98.8
27.0	2.6	52.5	17.3	78.0	49.9	103.5	98.9
27.5	2.9	53.0	17.7	78.5	50.8	104.0	99.7
28.0	3.0	53.5	18.5	79.0	51.6	104.5	99.7
28.5	3.1	54.0	18.9	79.5	52.5	105.0	100.0
29.0	3.3	54.5	19.4	80.0	53.5		

TABLE A-2

CUMULATIVE PERCENTAGES FOR RAW ALT A
(RAW VE + RAW AR + RAW GS + RAW MK) SCORE VALUES

VALUE	CUM %	VALUE	CUM %	VALUE	CUM %
0	.1	47	10.6	90	53.8
1	.1	48	11.3	91	55.1
2	.1	49	11.9	92	56.4
3	.1	50	12.6	93	57.9
6	.1	51	13.5	94	59.4
7	.1	52	14.3	95	60.9
8	.1	53	14.8	96	62.0
9	.1	54	15.6	97	63.4
10	.1	55	16.3	98	64.6
12	.2	56	17.0	99	65.9
13	.2	57	17.8	100	67.1
15	.2	58	18.5	101	68.6
16	.3	59	19.5	102	70.0
17	.3	60	20.2	103	71.4
18	.3	61	21.1	104	72.8
19	.3	62	21.9	105	74.1
20	.3	63	22.9	106	75.3
21	.4	64	23.8	107	76.4
22	.5	65	25.0	108	77.7
23	.6	66	25.8	109	79.1
24	.7	67	26.8	110	80.2
25	.8	68	27.6	111	81.3
26	1.0	69	28.9	112	82.4
27	1.3	70	29.7	113	83.7
28	1.5	71	31.0	114	84.9
29	1.8	72	32.0	115	86.2
30	2.1	73	33.2	116	87.6
31	2.4	74	34.2	117	88.6
32	2.8	75	35.6	118	89.8
33	3.3	76	36.6	119	90.9
34	3.8	77	37.6	120	92.2
35	4.2	78	38.8	121	93.3
36	4.7	79	40.0	122	94.5
37	5.0	80	41.1	123	95.7
38	5.5	81	42.3	124	96.5
39	5.9	82	43.8	125	97.4
40	6.6	83	45.1	126	98.3
41	7.1	84	46.3	127	99.0
42	7.7	85	47.4	128	99.5
43	8.3	86	48.5	129	99.9
44	8.9	87	49.8	130	100.0
45	9.5	88	51.3		
46	10.0	89	52.5		

TABLE A-3

CUMULATIVE PERCENTAGES FOR RAW ALT B (RAW VE + RAW AR + RAW MK) SCORE VALUES

VALUE	CUM %	VALUE	CUM %
0	.1	55	28.5
1	.1	56	30.0
2	.1	57	31.1
3	.1	58	32.3
4	.1	59	33.7
6	.1	60	34.8
7	.1	61	36.1
8	.2	62	37.4
9	.2	63	39.0
11	.2	64	40.5
12	.2	65	42.0
14	.3	66	43.3
15	.3	67	44.6
16	.3	68	46.1
17	.4	69	47.8
18	.6	70	49.2
19	.8	71	50.7
20	1.0	72	52.0
21	1.2	73	53.3
22	1.6	74	54.8
23	2.0	75	56.4
24	2.3	76	57.7
25	2.9	77	59.6
26	3.4	78	61.4
27	3.9	79	63.1
28	4.5	80	64.6
29	5.1	81	66.3
30	5.7	82	67.9
31	6.4	83	69.4
32	7.2	84	70.8
33	7.8	85	72.4
34	8.5	86	73.8
35	9.3	87	75.3
36	9.9	88	76.8
37	10.7	89	78.4
38	11.5	90	79.7
39	12.4	91	81.1
40	13.2	92	82.3
41	14.0	93	84.1
42	14.9	94	85.6
43	15.8	95	87.1
44	16.7	96	89.0
45	17.6	97	90.4
46	18.5	98	91.8
47	19.6	99	93.3
48	20.8	100	95.0
49	21.9	101	96.4
50	22.9	102	97.8
51	23.8	103	99.0
52	25.1	104	99.7
53	26.2	105	100.0
54	27.2		

TABLE A-4

CUMULATIVE PERCENTAGES FOR RAW ALT C (2*RAW VE + 2*RAW AR + RAW MK) SCORE VALUES

VALUE	CUM %	VALUE	CUM %	VALUE	CUM %
36	1.0	86	19.2	136	56.1
37	1.2	87	19.6	137	57.0
38	1.3	88	20.3	138	58.0
39	1.5	89	20.8	139	58.8
40	1.7	90	21.5	140	60.0
41	2.0	91	22.0	141	60.7
42	2.1	92	22.6	142	61.7
43	2.3	93	23.1	143	62.8
44	2.6	94	23.7	144	63.8
45	2.9	95	24.4	145	65.0
46	3.2	96	25.0	146	65.9
47	3.4	97	25.6	147	66.8
48	3.7	98	26.1	148	67.9
49	3.9	99	26.9	149	68.9
50	4.3	100	27.5	150	70.0
51	4.6	101	28.2	151	70.8
52	4.9	102	29.0	152	71.6
53	5.2	103	29.7	153	72.7
54	5.5	104	30.3	154	73.7
55	5.8	105	30.9	155	74.4
56	6.3	106	31.7	156	75.4
57	6.6	107	32.4	157	76.4
58	7.0	108	32.9	158	77.1
59	7.4	109	33.7	159	78.1
60	7.7	110	34.4	160	78.9
61	8.1	111	35.0	161	79.8
62	8.5	112	35.8	162	80.8
63	8.8	113	36.3	163	81.6
64	9.2	114	37.1	164	82.6
65	9.6	115	38.2	165	83.5
66	9.9	116	39.1	166	84.5
67	10.3	117	39.8	167	85.6
68	10.8	118	40.6	168	86.6
69	11.2	119	41.5	169	87.6
70	11.7	120	42.4	170	88.3
71	12.2	121	43.2	171	89.3
72	12.6	122	44.1	172	90.2
73	13.1	123	44.8	173	91.1
74	13.4	124	45.7	174	92.2
75	13.9	125	46.5	175	93.0
76	14.3	126	47.4	176	94.0
77	14.7	127	48.4	177	95.0
78	15.2	128	49.2	178	95.9
79	15.9	129	50.0	179	96.8
80	16.3	130	50.7	180	97.5
81	16.8	131	51.4	181	98.3
82	17.2	132	52.4	182	98.9
83	17.7	133	53.3	183	99.6
84	18.3	134	54.1	184	99.7
85	18.8	135	55.2	185	100.0

TABLE A-5

CUMULATIVE PERCENTAGES FOR STD1 ALT A (STD VE + STD AR + STD GS + STD MK) SCORE VALUES

VALUE	CUM %	VALUE	CUM %	VALUE	CUM %
123	1.0	171	23.6	219	66.1
124	1.2	172	24.5	220	66.9
125	1.4	173	25.4	221	68.1
126	1.6	174	26.4	222	68.9
127	1.8	175	27.1	223	70.0
128	2.1	176	27.8	224	70.9
129	2.4	177	28.4	225	72.0
130	2.7	178	28.9	226	72.9
131	3.0	179	29.6	227	74.0
132	3.3	180	30.6	228	74.7
133	3.7	181	31.4	229	75.7
134	3.9	182	32.3	230	76.6
135	4.3	183	33.1	231	77.5
136	4.6	184	34.2	232	78.4
137	4.9	185	35.1	233	79.3
138	5.3	186	35.8	234	79.9
139	5.7	187	36.6	235	80.5
140	6.2	188	37.6	236	81.5
141	6.6	189	38.4	237	82.4
142	7.1	190	39.2	238	83.2
143	7.4	191	39.9	239	84.0
144	7.8	192	40.9	240	84.6
145	8.3	193	42.0	241	85.5
146	8.8	194	43.0	242	86.1
147	9.1	195	44.0	243	87.1
148	9.7	196	44.8	244	87.8
149	10.2	197	45.8	245	88.6
150	10.7	198	46.6	246	89.5
151	11.1	199	47.8	247	90.1
152	11.7	200	48.7	248	91.1
153	12.2	201	49.5	249	92.0
154	13.0	202	50.3	250	92.7
155	13.4	203	51.0	251	93.5
156	14.1	204	51.9	252	94.2
157	14.6	205	52.8	253	94.9
158	15.3	206	54.0	254	95.6
159	15.8	207	54.7	255	96.2
160	16.5	208	55.9	256	97.0
161	17.1	209	56.9	257	97.5
162	17.6	210	58.2	258	98.1
163	18.1	211	59.1	259	98.5
164	18.8	212	60.0	260	98.9
165	19.6	213	61.1	261	99.3
166	20.3	214	62.3	262	99.6
167	21.0	215	63.1	263	99.9
168	21.6	216	63.7	264	100.0
169	22.4	217	64.6		
170	23.0	218	65.4		

TABLE A-6

CUMULATIVE PERCENTAGES FOR STD1 ALT B (STD VE + STD AR + STD MK) SCORE VALUES

VALUE	CUM %	VALUE	CUM %	VALUE	CUM %
75	.1	117	14.7	157	56.7
76	.1	118	15.6	158	58.3
77	.1	119	16.4	159	59.4
79	.1	120	17.3	160	60.5
80	.1	121	18.0	161	61.9
81	.2	122	19.1	162	63.2
82	.2	123	20.1	163	64.6
83	.2	124	21.1	164	65.5
84	.2	125	22.0	165	66.8
85	.2	126	23.0	166	68.0
86	.3	127	23.9	167	69.2
87	.3	128	24.8	168	70.1
88	.3	129	25.6	169	71.3
89	.4	130	26.7	170	72.6
90	.5	131	27.9	171	73.6
91	.6	132	29.0	172	74.6
92	.8	133	29.9	173	76.0
93	1.0	134	31.1	174	77.2
94	1.2	135	32.1	175	78.3
95	1.4	136	33.1	176	79.1
96	1.7	137	34.2	177	80.4
97	2.1	138	35.3	178	81.1
98	2.5	139	36.4	179	82.0
99	2.9	140	37.6	180	83.1
100	3.3	141	38.6	181	84.2
101	3.8	142	39.8	182	85.5
102	4.3	143	40.8	183	86.7
103	4.9	144	41.9	184	87.9
104	5.4	145	42.8	185	89.1
105	6.0	146	44.2	186	90.3
106	6.7	147	45.4	187	91.1
107	7.3	148	46.5	188	92.4
108	8.1	149	47.9	189	93.7
109	8.7	150	49.1	190	95.0
110	9.5	151	50.2	191	96.1
111	10.1	152	51.4	192	97.3
112	10.9	153	52.4	193	98.4
113	11.6	154	53.4	194	99.1
114	12.4	155	54.4	195	99.7
115	13.0	156	55.6	196	100.0
116	13.7				

TABLE A-7

CUMULATIVE PERCENTAGES FOR STD1 ALT C
(2 * STD VE + 2 * STD AR + STD MK) SCORE VALUES

VALUE	CUM %	VALUE	CUM %	VALUE	CUM %	VALUE	CUM %
151	1.0	195	14.9	238	38.8	281	70.7
152	1.1	196	15.4	239	39.5	282	71.4
153	1.2	197	15.9	240	40.4	283	72.0
154	1.3	198	16.3	241	40.9	284	72.8
155	1.5	199	16.7	242	41.6	285	73.3
156	1.7	200	17.2	243	42.3	286	74.3
157	2.0	201	17.7	244	43.0	287	74.8
158	2.1	202	18.2	245	43.6	288	75.8
159	2.4	203	18.7	246	44.5	289	76.4
160	2.6	204	19.2	247	45.1	290	77.2
161	2.9	205	19.6	248	46.0	291	77.8
162	3.1	206	20.3	249	46.7	292	78.7
163	3.4	207	20.8	250	47.6	293	79.1
164	3.5	208	21.3	251	48.2	294	79.8
165	3.8	209	21.8	252	48.8	295	80.4
166	4.1	210	22.3	253	49.4	296	81.1
167	4.4	211	22.8	254	50.3	297	81.8
168	4.6	212	23.3	255	51.1	298	82.5
169	4.9	213	23.8	256	51.7	299	83.1
170	5.2	214	24.4	257	52.4	300	83.9
171	5.6	215	24.9	258	53.2	301	84.6
172	5.9	216	25.6	259	53.7	302	85.5
173	6.2	217	26.1	260	54.3	303	86.0
174	6.5	218	26.7	261	55.1	304	87.1
175	6.9	219	27.3	262	55.7	305	87.6
176	7.2	220	27.9	263	56.4	306	88.5
177	7.6	221	28.4	264	57.1	307	89.0
178	8.0	222	28.9	265	58.0	308	89.7
179	8.4	223	29.6	266	58.6	309	90.4
180	8.8	224	30.3	267	59.3	310	91.3
181	9.2	225	30.7	268	60.2	311	92.0
182	9.5	226	31.3	269	61.0	312	92.9
183	10.0	227	31.9	270	61.9	313	93.4
184	10.2	228	32.6	271	62.5	314	94.3
185	10.6	229	33.2	272	63.6	315	95.0
186	11.0	230	33.9	273	64.5	316	96.0
187	11.5	231	34.3	274	65.2	317	96.6
188	11.9	232	35.0	275	66.0	318	97.5
189	12.3	233	35.4	276	66.9	319	97.8
190	12.6	234	36.2	277	67.6	320	98.9
191	13.2	235	36.8	278	68.4	321	99.0
192	13.7	236	37.7	279	69.0	322	99.7
193	14.2	237	38.0	280	69.9	324	100.0
194	14.6						

TABLE A-8

CUMULATIVE PERCENTAGES FOR STD2 ALT A (STD WK + STD PC + STD AR + STD GS + STD MK) SCORE VALUES

VALUE	CUM %	VALUE	CUM %	VALUE	CUM %	VALUE	CUM %
150	1.0	194	13.8	238	37.2	282	72.8
151	1.1	195	14.3	239	37.7	283	73.7
152	1.3	196	14.7	240	38.4	284	74.3
153	1.4	197	15.1	241	39.2	285	75.1
154	1.6	198	15.4	242	40.0	286	75.9
155	1.7	199	15.7	243	40.7	287	76.7
156	2.0	200	16.1	244	41.5	288	77.6
157	2.2	201	16.4	245	42.4	289	78.3
158	2.4	202	16.8	246	43.2	290	79.2
159	2.6	203	17.4	247	43.9	291	79.8
160	2.9	204	17.8	248	44.7	292	80.5
161	3.1	205	18.2	249	45.4	293	81.2
162	3.2	206	18.7	250	46.3	294	82.0
163	3.5	207	19.1	251	47.0	295	82.6
164	3.8	208	19.6	252	47.6	296	83.3
165	4.0	209	20.2	253	48.5	297	84.0
166	4.2	210	20.6	254	49.2	298	85.0
167	4.5	211	21.0	255	50.2	299	86.0
168	4.8	212	21.4	256	50.9	300	86.7
169	5.0	213	22.0	257	51.7	301	87.2
170	5.4	214	22.4	258	52.4	302	87.9
171	5.6	215	23.0	259	53.2	303	88.9
172	6.0	216	23.8	260	54.0	304	89.5
173	6.2	217	24.4	261	54.7	305	90.4
174	6.5	218	24.9	262	55.9	306	90.9
175	6.9	219	25.6	263	56.8	307	91.5
176	7.2	220	26.0	264	57.8	308	92.3
177	7.6	221	26.4	265	58.5	309	93.2
178	8.0	222	27.0	266	59.3	310	93.9
179	8.3	223	27.6	267	60.2	311	94.4
180	8.6	224	28.1	268	61.1	312	94.8
181	8.9	225	28.5	269	62.0	313	95.6
182	9.2	226	29.1	270	62.7	314	96.2
183	9.6	227	30.0	271	63.6	315	96.7
184	9.9	228	30.5	272	64.4	316	97.2
185	10.2	229	31.3	273	65.3	317	97.8
186	10.6	230	32.2	274	66.1	318	98.3
187	11.0	231	32.9	275	66.8	319	98.8
188	11.3	232	33.2	276	67.6	320	99.1
189	11.7	233	33.9	277	68.6	321	99.3
190	12.1	234	34.6	278	69.1	322	99.7
191	12.5	235	35.5	279	70.1	323	99.8
192	13.0	236	36.0	280	71.0	324	99.9
193	13.3	237	36.6	281	71.9	325	100.0

TABLE A-9

CUMULATIVE PERCENTAGES FOR STD2 ALT B (STD WK + STD PC + STD AR + STD MK) SCORE VALUES

VALUE	CUM %	VALUE	CUM %	VALUE	CUM %
120	1.0	166	19.9	212	57.5
121	1.2	167	20.5	213	58.5
122	1.3	168	21.2	214	59.7
123	1.5	169	21.7	215	61.0
124	1.7	170	22.7	216	62.1
125	1.9	171	23.3	217	63.1
126	2.2	172	23.8	218	64.0
127	2.5	173	24.3	219	65.3
128	2.8	174	24.9	220	66.2
129	3.1	175	25.8	221	67.3
130	3.4	176	26.6	222	68.4
131	3.7	177	27.1	223	69.5
132	4.0	178	27.7	224	70.4
133	4.4	179	28.5	225	71.3
134	4.8	180	29.3	226	72.3
135	5.2	181	29.9	227	73.3
136	5.5	182	30.6	228	74.2
137	6.0	183	31.4	229	75.4
138	6.4	184	32.1	230	76.2
139	6.8	185	33.1	231	77.0
140	7.3	186	33.7	232	78.1
141	7.7	187	34.4	233	78.9
142	8.0	188	35.1	234	80.0
143	8.4	189	35.8	235	81.0
144	8.8	190	36.6	236	82.1
145	9.2	191	37.6	237	83.1
146	9.8	192	38.8	238	84.0
147	10.2	193	39.8	239	85.0
148	10.6	194	40.7	240	85.9
149	11.1	195	41.7	241	86.9
150	11.6	196	42.6	242	88.1
151	12.1	197	43.5	243	89.1
152	12.6	198	44.2	244	90.1
153	13.1	199	45.2	245	91.1
154	13.6	200	46.0	246	92.0
155	14.1	201	46.8	247	93.2
156	14.6	202	47.8	248	94.1
157	15.0	203	49.1	249	95.0
158	15.4	204	50.1	250	95.9
159	15.9	205	50.9	251	96.8
160	16.4	206	51.9	252	97.7
161	17.1	207	52.9	253	98.5
162	17.8	208	54.0	254	99.2
163	18.5	209	54.8	255	99.5
164	18.9	210	55.6	256	99.7
165	19.5	211	56.5	257	100.0

TABLE A-10

CUMULATIVE PERCENTAGES FOR STD2 ALT C
(2*STD WK + 2*STD PC + 2*STD AR + STD MK) SCORE VALUES

VALUE	CUM %	VALUE	CUM %	VALUE	CUM %	VALUE	CUM %
205	1.0	296	21.3	346	42.5	396	72.5
214	2.0	297	21.7	347	42.8	397	73.0
221	3.1	298	22.1	348	43.3	398	73.7
227	4.1	299	22.5	349	43.7	399	74.1
232	5.1	300	22.9	350	44.5	400	74.8
236	6.0	301	23.2	351	44.9	401	75.3
241	7.1	302	23.6	352	45.4	402	75.9
245	8.0	303	24.0	353	45.9	403	76.3
250	9.1	304	24.3	354	46.6	404	77.2
254	10.0	305	24.7	355	47.1	405	77.6
255	10.2	306	25.0	356	47.7	406	78.5
256	10.4	307	25.3	357	48.3	407	79.0
257	10.6	308	25.6	358	49.0	408	79.7
258	10.9	309	25.9	359	49.5	409	80.1
259	11.0	310	26.4	360	50.1	410	80.8
260	11.3	311	26.5	361	50.7	411	81.4
261	11.5	312	26.9	362	51.3	412	82.1
262	11.7	313	27.3	363	51.8	413	82.7
263	11.9	314	27.6	364	52.2	414	83.5
264	12.2	315	28.1	365	52.7	415	84.0
265	12.6	316	28.5	366	53.1	416	84.7
266	12.8	317	28.9	367	53.7	417	85.2
267	13.2	318	29.3	368	54.3	418	85.7
268	13.4	319	29.6	369	54.9	419	86.4
269	13.7	320	30.2	370	55.7	420	87.2
270	13.9	321	30.6	371	56.4	421	87.8
271	14.2	322	31.3	372	56.9	422	88.5
272	14.5	323	31.5	373	57.5	423	89.0
273	14.8	324	31.9	374	58.0	424	89.8
274	15.0	325	32.4	375	58.6	425	90.2
275	15.2	326	32.8	376	59.3	426	90.8
276	15.5	327	33.1	377	60.0	427	91.3
277	15.7	328	33.5	378	60.6	428	92.1
278	16.0	329	33.9	379	61.2	429	92.6
279	16.3	330	34.2	380	61.9	430	93.3
280	16.6	331	34.4	381	62.6	431	93.7
281	16.9	332	34.9	382	63.2	432	94.5
282	17.2	333	35.2	383	63.8	433	95.0
283	17.5	334	35.9	384	64.7	434	95.6
284	17.8	335	36.3	385	65.3	435	95.9
285	18.1	336	36.8	386	66.2	436	96.5
286	18.4	337	37.3	387	66.8	437	96.9
287	18.7	338	38.0	388	67.4	438	97.9
288	19.0	339	38.3	389	68.0	439	98.2
289	19.3	340	38.9	390	68.7	440	98.8
290	19.6	341	39.5	391	69.1	441	98.9
291	19.9	342	40.1	392	69.9	442	99.3
292	20.1	343	40.7	393	70.5	443	99.4
293	20.5	344	41.4	394	71.2	444	99.7
294	20.8	345	41.9	395	71.8	446	100.0
295	21.0						

APPENDIX B

COMPUTER PROGRAM FOR CALCULATING AFQT SCORE VALUES FOR VARIOUS WAYS OF DEFINING THE AFQT

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*********************************************************************
*                                                                   *
*          COMPUTER PROGRAM FOR CALCULATING AFQT SCORE VALUES       *
*                FOR VARIOUS WAYS OF DEFINING THE AFQT              *
*                                                                   *
*********************************************************************

*********************************************************************
        RECODE SPEEDED TESTS USING THE JANUARY 1984 CORRECTION
*********************************************************************
COMPUTE          JAN84NO = RAWNO
RECODE           JAN84NO (48 THRU 50=50) (47=49) (46=49) (45=48) (44=47)
                   (43=46) (42=45) (41=44) (40=43) (39=42) (38=41)
                   (37=40) (36=39) (35=39) (34=38) (33=37) (32=36)
                   (31=35) (30=34) (29=33) (28=31) (27=30) (26=29)
                   (25=28) (24=27) (23=26) (22=25) (21=24) (20=23)
RECODE           JAN84NO (19=22) (18=21) (17=19) (16=18) (15=17)
                   (14=16) (13=15) (12=14) (11=12) (10=11) (9=10)
                   (8=9) (7=8) (6=6) (5=5) (4=4) (3=2) (2=1) (1=0)
COMPUTE          JAN84CS = RAWCS
RECODE           JAN84CS (82 THRU 84=84) (81=83) (80=82) (79=81)
                   (78=80) (77=79) (76=78) (75=77) (74=76) (73=75)
                   (72=74) (71=73) (70=72) (69=71) (68=70) (67=69)
                   (66=68) (65=67) (64=66) (63=65) (62=64) (61=63)
RECODE           JAN84CS (60=62) (59=61) (58=60) (57=59) (56=58)
                   (55=57) (54=56) (53=55) (52=54) (51=53) (50=51)
                   (49=50) (48=49) (47=48) (46=47) (45=46) (44=45)
                   (43=44) (42=43) (41=42) (40=41) (39=40) (38=39)
RECODE           JAN84CS (37=38) (36=37) (35=36) (34=35) (33=34)
                   (32=33) (31=32) (30=31) (29=30) (28=29) (27=28)
                   (26=27) (25=26) (24=25) (23=24) (22=23) (21=22)
                   (20=21) (19=20) (18=18) (17=17) (16=16) (15=15)
RECODE           JAN84CS (14=14) (13=13) (12=12) (11=11) (10=10)
                   (9=9) (8=8) (7=7) (6=6) (5=5) (4=4) (3=3)
                   (2=2) (1=1)

*********************************************************************
                  COMPUTE VE AS THE SUM OF WK + PC
*********************************************************************
COMPUTE                RAWVE = RAWWK + RAWPC

*********************************************************************
                     COMPUTE STANDARD SCORES
*********************************************************************
COMPUTE                STDGS = RND(50 + 10*(RAWGS - 15.950)/5.010)
COMPUTE                STDAR = RND(50 + 10*(RAWAR - 18.009)/7.373)
COMPUTE                STDWK = RND(50 + 10*(RAWWK - 26.270)/7.710)
COMPUTE                STDPC = RND(50 + 10*(RAWPC - 11.011)/3.355)
COMPUTE                STDNO = RND(50 + 10*(JAN84NO - 37.236)/10.800)
COMPUTE                STDCS = RND(50 + 10*(JAN84CS - 47.606)/16.763)
COMPUTE                STDAS = RND(50 + 10*(RAWAS - 14.317)/5.550)
COMPUTE                STDMK = RND(50 + 10*(RAWMK - 13.578)/6.393)
COMPUTE                STDMC = RND(50 + 10*(RAWMC - 14.165)/5.349)
COMPUTE                STDEI = RND(50 + 10*(RAWEI - 11.569)/4.236)
COMPUTE                STDVE = RND(50 + 10*(RAWVE - 37.281)/10.595)
```

```
*************************************************************************
          BIND SUBTEST STANDARD SCORES BETWEEN 20 AND 80
*************************************************************************
IF              (STDGS LT 20) STDGS=20
IF              (STDAR LT 20) STDAR=20
IF              (STDWK LT 20) STDWK=20
IF              (STDPC LT 20) STDPC=20
IF              (STDNO LT 20) STDNO=20
IF              (STDCS LT 20) STDCS=20
IF              (STDAS LT 20) STDAS=20
IF              (STDMK LT 20) STDMK=20
IF              (STDMC LT 20) STDMC=20
IF              (STDEI LT 20) STDEI=20
IF              (STDVE LT 20) STDVE=20
IF              (STDGS GT 80) STDGS=80
IF              (STDAR GT 80) STDAR=80
IF              (STDWK GT 80) STDWK=80
IF              (STDPC GT 80) STDPC=80
IF              (STDNO GT 80) STDNO=80
IF              (STDCS GT 80) STDCS=80
IF              (STDAS GT 80) STDAS=80
IF              (STDMK GT 80) STDMK=80
IF              (STDMC GT 80) STDMC=80
IF              (STDEI GT 80) STDEI=80
IF              (STDVE GT 80) STDVE=80


*************************************************************************
    COMPUTE AFQT SCORE VALUES FOR VARIOUS WAYS OF DEFINING THE AFQT
*************************************************************************
COMPUTE                 CURRENT = RAWVE + RAWAR + JAN84NO/2
COMPUTE                 RAWALTA = RAWVE + RAWAR + RAWGS + RAWMK
COMPUTE                 RAWALTB = RAWVE + RAWAR + RAWMK
COMPUTE                 RAWALTC = 2*RAWVE + 2*RAWAR + RAWMK
COMPUTE                 STD1ALTA = STDVE + STDAR + STDGS + STDMK
COMPUTE                 STD1ALTB = STDVE + STDAR + STDMK
COMPUTE                 STD1ALTC = 2*STDVE + 2*STDAR + STDMK
COMPUTE                 STD2ALTA = STDWK + STDPC + STDAR + STDGS + STDMK
COMPUTE                 STD2ALTB = STDWK + STDPC + STDAR + STDMK
COMPUTE                 STD2ALTC = 2*STDWK + 2*STDPC + 2*STDAR + STDMK
```